

REMARKS

Applicant has amended claims 1, 2, 5, 6, 8 and 9 and cancelled claims 3, 7 and 10.

Applicant respectfully requests reconsideration in view of the earlier-submitted Declaration and the following remarks.

Since the method claims of Invention II contain the composition limitations of claim 1, Applicant respectfully requests reconsideration of the restriction requirement under MPEP § 821.04 upon the allowance of claims 1 to 7.

Applicant has amended the claims to the particular water-soluble polymer of polymaleic acid. Applicant has discovered that at acidic pH levels, polymaleic acid can improve erosion performance for barrier slurries. The specification provides a basis for the amendment with Examples 1 to 4. Applicant respectfully submits that the amendment enters no new matter.

The action rejects claims 1 to 7 under 35 U.S.C. § 103(a) as being unpatentable over Sun et al. (US Pat. No. 6,709,316) in view of Yano et al. (US Pat. No. 6,375,5645). The Sun et al. reference describes a first-step copper slurry at Col. 6, line 33 to Col. 8, line 39 and a barrier slurry at Col. 8, line 40 to Col. 9, line 65. The action includes ingredients from the first-step copper slurry to reject the claimed barrier slurry of the invention. As stated in the earlier-provided Declaration of Dr. Liu, because first-step copper slurries operate to remove copper at high rates with low barrier removal rates, they teach away from use of a barrier removal slurry. Furthermore, the reference of Sun et al. does not disclose a second step barrier removal slurry that operates at a pH below 4. In fact the prophetic-type barrier slurry Example of Sun et al. operates at a basic pH of 8 to 12. This teaches also away from the acidic barrier slurry of the invention. In addition, Sun et al. fail to disclose a pH less than 4 adjusted with an inorganic acid for use in a barrier slurry (Col. 8, line 40 to Col. 9, line 65).

The Yano et al. reference teaches the use of a maleic acid monomer (Col. 8, line 1) to form an abrasive polymeric particle, not a water soluble polymer additive for use in a barrier slurry—a polymeric particle is not equivalent to a water-soluble polymer. Applicant's amended claims cover water soluble polymaleic acid. The action states that Yano et al. disclose the use of polymers containing a hydrophilic group—this would provide wettability to the polymeric particles, but it is not equivalent to the claimed water-soluble polymer. For example, silica particles at a pH between 2 and 11 contain hydroxyl groups that render the particles hydrophilic—these particles may form a dispersion, but are insoluble in water. The claimed carboxylic acid polymers can limit dielectric erosion without adversely impacting barrier removal rate. Thus, since Sun et al. disclose a slurry designed for bulk copper removal, teach away from using a pH less than 4 for barrier polishing, do not disclose use of an inorganic acid to adjust the pH for barrier polishing, Yano et al. disclose monomers for forming polymeric particles, not a slurry additive and Yano et al. do not disclose the claimed water soluble polymer for barrier applications, Applicant respectfully submits that the combined references fail to disclose or suggest the claims, as amended.

With respect to claim 2, Sun et al. disclose a chelating agent, but fail to disclose a water soluble polymaleic acid for use as a slurry additive. These polymers can limit dielectric erosion without detrimentally impacting tantalum removal rate. Furthermore, the polymer particle disclosure of Yano et al. fails to disclose the claimed water soluble polymaleic acid.

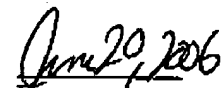
With respect to claim 4, Sun et al. at Col. 7, lines 53 to 59 do disclose a pH range of 2.5 to 11. But this range is for the first step slurry that removes copper. The pH range for the second step slurry that removes barrier is 4 to 12—see top of column 9. Applicant has earlier amended the range to no longer overlap the range at a pH of 4.

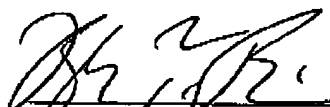
With respect to claim 5, Sun et al. fail to teach the pH range for a barrier slurry, teaches away by having the preferred barrier slurry operate with a basic pH; and the Yano et al. reference teaches a polymeric particle, not water-soluble polymaleic acid for improving performance of a barrier slurry.

With respect to claim 6, please refer to the above arguments to claim 2.

Applicant respectfully submits that the amended claims are in proper form for allowance and respectfully request reconsideration. If a telephone call would expedite prosecution, please call me at 302 283-2136.

Respectfully submitted,


Date


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